Claims

1. An optical system for producing an illuminated strip (01) on a surface (02) of a material (03), with an illumination device (06) having several light sources (07) arranged at a distance (A07) from the surface (02) of the material (03), with the illumination device (06) with its light sources (07) producing the illuminated strip (01) on the surface (02) of the material (03), which is in motion relative to the illumination device (06), with the illumination device (06) having at least one mirror (11; 16) bundling the light emitted by the light sources (07) onto the illuminated strip (01) and having a diffuser (38) on its light exit side facing the surface (02) of the material (03), characterized in that the illumination device (06) has at least one reflector module (39), with the light sources (07) feeding their light into the reflector module (39), with the reflector module (39) embodying the diffuser (38) and the mirror (11; 16) in one individual component.

2. The optical system in accordance with Claim 1, characterized in that the illumination device (06) comprising several modules (M61 to M65) arranged in a row next to one another, each having several light sources (07) arranged next to one another.

3. The optical system in accordance with Claim 2, characterized in that several of the modules (M61 to M65) that are arranged in a row next to one another have at least one reflector module (39).

4. The optical system in accordance with Claim 1, characterized in that the light sources (07) are divided into groups.

5. The optical system in accordance with Claim 4, characterized in that a control device (23) is provided, with the control device (23) controlling a group of light sources (07) independently of at least one other group of light sources (07).

6. The optical system in accordance with Claim 2, characterized in that a line length of the illumination device (06) comprising several modules (M61 to M65) arranged in a row next to one another corresponding to the width (B03) of the material (03) to be illuminated may be activated by switching on the light sources (07) of the modules (M61 to M65) in question.

7. The optical system in accordance with Claim 2, characterized in that a line length of the illumination device (06) comprising several modules (M61 to M65) arranged in a row next to one another corresponding to the length (L01) of the illuminated strip (01) may be activated by switching on the light sources (07) of the modules (M61 to M65) in question.

8. An optical system for producing an illuminated strip (01) on a surface (02) of a material (03), with an illumination device (06) having several light sources (07) being arranged at a distance (A07) from the surface (02) of the material (03), with the illumination device (06) with its light sources (07) emitting light producing the illuminated strip (01) on the surface (02 of the material (03), which is in motion relative to the illumination device (06), with the illumination device (06) comprising several modules (M61 to M65) arranged next to one another in a row, with each module (M61 to M65) having at least one light source (07), characterized in that a control device (23) connected to the illumination device (06) controls the at least one light source (07) each of at least two different modules (M61 to M65) independently of the at least one light source (07) of each of the other modules (M61 to M65).

9. The optical system in accordance with Claim 8, characterized in that the illumination device (06) has a mirror (11; 16) bundling the light emitted by the at least one light source (07) onto the illuminated strip (01).

10. The optical system in accordance with Claim 8, characterized in that the illumination device (06) has a diffuser (38) on its side facing the surface (02) of the material (03).

11. The optical system in accordance with Claim 8, characterized in that the illumination device (06) has at least one reflector module (39).

12. The optical system in accordance with Claim 8, characterized in that each module (M61 to M65) has at least one reflector module (39).

13. The optical system in accordance with Claim 8, characterized in that the at least one light source (07) of each module (M61 to M65) feeds its light into the respective reflector module (39).

14. The optical system in accordance with Claim 9 and 10, characterized in that the reflector module (39) embodies the diffuser (38) and the mirror (11; 16) in one single component.

15. The optical system in accordance with Claim 8, characterized in that each module (M61 to M65) has at least one group of several light sources (07).

16. The optical system in accordance with Claim 8, characterized in that all light sources (07) of the same group each feed their light into the same reflector module (39).

17. The optical system in accordance with Claim 8, characterized in that each module (M61 to M65) has a control device (23) for controlling the at least one light source (07) of each module (M61 to M65).

18. The optical system in accordance with Claim 2 or 8, characterized in that an interstice (26) is arranged between two neighboring modules (M61 to M65) transverse to the length (L01) of the illuminated strip (01).

19. The optical system in accordance with Claim 2 or 8, characterized in that the modules (M61 to M65) of the illumination device (06) are embodied in a functionally identical manner.

20. The optical system in accordance with Claim 1 or 8, characterized in that the light sources (07) are disposed on a plate (21) cooled by a coolant.

21. The optical system in accordance with Claim 1 or 8, characterized in that the light sources (07) and their respective power sources (22) are disposed on the same plate (21).

22. The optical system in accordance with Claim 1, 11, or 12, characterized in that the reflector module (39) is disposed on the plate (21) carrying the light sources (07) or on the carrier (27).

23. The optical system in accordance with Claim 1 or 10, characterized in that the diffuser (38) is embodied on the light exit surface of the reflector module (39) as a grooved structure.

24. The optical system in accordance with Claim 23, characterized in that the grooved structure of the diffuser (38) is formed onto the light exit surface of the reflector module (39).

25. The optical system in accordance with Claim 1, 11, or 12, characterized in that the reflector module (39) has a depression extending in the longitudinal direction of the illumination device

(06).

26. The optical system in accordance with Claim 25, characterized in that the depression divides the light exit surface of the reflector module (39) into two partial areas, with at least one of these partial areas of the light exit surface of the reflector module (39) being in turn embodied as a lens.

27. The optical system in accordance with Claim 26, characterized in that both partial areas of the light exit surface of the reflector module (39) are embodied with equal widths.

28. The optical system in accordance with Claim 26, characterized in that the partial area of the light exit surface of the reflector module (39) that is embodied as a lens is embodied as a convex lens.

29. The optical system in accordance with Claim 26, characterized in that at least one of these partial areas of the light exit surface of the reflector module (39) bundles the beam of light exiting at the light exit surface of the reflector module (39) in the direction of the illuminated strip (01) to be formed on the surface (02) of the material (03).

30. The optical system in accordance with Claim 1 or 9, characterized in that the reflector module is embodied as a massive formed component, with no optically relevant boundary surface separating the diffuser (38) from the at least one mirror (11; 16) in the formed component.

31. The optical system in accordance with Claim 1 or 10, characterized in that the diffuser (38) is embodied as a lenticular or as a prismatic film.

32. The optical system in accordance with Claim 1, 11, or 12, characterized in that the light sources (07) are arranged on the side of the reflector module (39) diametrically opposite the light exit side.

33. The optical system in accordance with Claim 1, 11, or 12, characterized in that the light sources (07) are indented into the reflector module (39) on the side of the reflector module (39) diametrically opposite the light exit side.

34. The optical system in accordance with Claim 1, 11, or 12, characterized in that the reflector module (39) is made of a plastic.

35. The optical system in accordance with Claim 1, 11, or 12, characterized in that the reflector module (39) is made of a transparent plastic.

36. The optical system in accordance with Claim 1, 11, or 12, characterized in that the reflector module (39) is produced by means of injection molding.

37. The optical system in accordance with Claim 1, 11, or 12, characterized in that the reflector module (39) is constructed of several segments arranged next to one another in a row in the longitudinal direction of the illumination device (06), with each segment forming the light optical path of one of the light sources (07) fed into the reflector module (39).

38. The optical system in accordance with Claim 1, 11, or 12, characterized in that the reflector module (39) forms and homogenizes the light emitted by the light sources (07) with regard to the illuminated strip (01).

39. The optical system in accordance with Claim 1 or 8, characterized in that the illumination device (06) forms the illuminated strip (01) with a width (B01) extending orthogonally to its length (L01) on the surface (02) of the material (03).

40. The optical system in accordance with Claim 1 or 8, characterized in that the illuminated strip (01) is disposed outside of a focal point of the light emitted by the light sources (07) located in the optical path.

41. The optical system in accordance with Claim 1 or 9, characterized in that the mirror (11) has at least one active surface (12) directed along the length (L01) and/or the width (B01) of the illuminated strip (01).

42. The optical system in accordance with Claim 41, characterized in that the mirror (11) with its active surface (12) constricts the light emitted by at least one of the light sources (07) of the illumination device (06) in a solid angle ($\omega$) into a smaller first enveloping surface (AH1) than the spherical surface (AK) pertaining to the solid angle ($\omega$).

43. The optical system in accordance with Claim 1 or 9, characterized in that another mirror (16) having at least one active surface (17) is arranged in a central area (14) surrounding the optical path of the central beam (13) within the solid angle (ω) of the light emitted by at least one of the light sources (07) of the illumination device (06).

44. The optical system in accordance with Claim 43, characterized in that the active surface (17) of the other mirror (16) first diverts the light emitted by at least one of the light sources (07) of the illumination device (06) against at least one active surface (12) of the first mirror (11) that is directed along the length (L01) or the width (B01) of the illuminated strip (01) and then the active surface (12) of the first mirror (11) diverts it to the illuminated strip (01).

45. The optical system in accordance with Claim 1 or 8, characterized in that at least one lens (18) is arranged in a central area (14) surrounding the optical path of the central beam (13) within the solid angle (ω) of the light emitted by at least one of the light sources (07) of the illumination device (06).

46. The optical system in accordance with Claim 45, characterized in that the lens (18) bundles at least part of the light emitted by at least one of the light sources (07) in the solid angle (ω) that was not deflected onto the illuminated strip (01) by the active surface (12) of the first mirror (11).

47. The optical system in accordance with Claim 1 or 8, characterized in that the light emitted by the light source (07) is bundled more strongly along the length (L01) of the illuminated strip (01) than the light along its width (B01).

48. The optical system in accordance with Claim 1, 9, or 45, characterized in that the arrangement of the mirrors (11; 16) and/or the lens are embodied as being integrated into the reflector module (39).

49. The optical system in accordance with Claim 42, characterized in that the solid angle (ω) spans a surface (AK) cut from a sphere, up to the size of a hemisphere.

50. The optical system in accordance with Claim 1 or 9, characterized in that the at least one active surface (12) of the first mirror (11) that is directed along the length (L01) of the illuminated strip (01) constricts the light emitted in the solid angle (ω) from at least one of the light sources

(07) of the illumination device (06) more strongly onto a smaller second enveloping surface (AH2) than the at least one active surface (12) of the first mirror (11) directed along the width (B01) of the illuminated strip (01).

51. The optical system in accordance with Claim 1 or 8, characterized in that at least one light source (07) of the illumination device (06) has a first mirror with at least two active surfaces (12) that are symmetrical to the central beam (13) emitted by the light source (07).

52. The optical system in accordance with Claim 1 or 9, characterized in that the active surface (12) of the first mirror (11) is embodied as planar or concave.

53. The optical system in accordance with Claim 43, characterized in that the active surface (17) of the second mirror (16) is embodied as planar or concave.

54. The optical system in accordance with Claim 1 or 9, characterized in that, at each individual light source (07) of the illumination device (06) one first mirror (11) with at least one active surface (12) is provided, at least along the width (B01) of the illuminated strip (01).

55. The optical system in accordance with Claim 45, characterized in that the lens (18) is embodied as a biconvex lens (18).

56. The optical system in accordance with Claim 45, characterized in that a distance (A18) is present between the light source (07) and a center (Z18) of the lens, with the distance (A18) being less than half of the distance (A07) between the light source (07) and the surface (02) of the material (03).

57. The optical system in accordance with Claim 45, characterized in that the lens (18) is not embodied in a rotationally symmetrical fashion.

58. The optical system in accordance with Claim 42, characterized in that the respective solid angles ($\omega$) or at least the enveloping surfaces (AH1; AH2) of the light emitted by at least two neighboring light sources (07) of the illumination device (06) overlap in at least one partial area (19) illuminated by the illuminated strip (01).

59. The optical system in accordance with Claim 42, characterized in that the respective solid angles (ω) or at least the enveloping surfaces (AH1; AH2) of the light emitted by at least two neighboring light sources (07) of the illumination device (06) arranged in two neighboring modules (M61 to M65) overlap in at least their partial area (19) illuminated by the illuminated strip (01).

60. The optical system in accordance with Claim 1 or 8, characterized in that all light sources (07) of the illumination device (06) are embodied in the same manner.

61. The optical system in accordance with Claim 1 or 8, characterized in that the light sources (07) of the illumination device (06) are embodied as light diodes (07) or as laser diodes (07).

62. The optical system in accordance with Claim 1 or 8, characterized in that the light sources (07) of the illumination device (06) emit monochromatic light.

63. The optical system in accordance with Claim 1 or 8, characterized in that the direction of motion (04) of the material (03) is linear.

64. The optical system in accordance with Claim 1 or 15, characterized in that the light sources (07) are arranged in a line.

65. The optical system in accordance with Claim 64, characterized in that the light sources (07) of the illumination device (06) that are arranged in a line are arranged parallel to the length (L01) of the illuminated strip (01).

66. The optical system in accordance with Claim 1 or 8, characterized in that the direction of motion (04) of the material (03) is oriented essentially parallel to the width (B01) of the illuminated strip (01).

67. The optical system in accordance with Claim 1 or 8, characterized in that the material (03) is not arched, at least in the area of the illuminated strip (01).

68. The optical system in accordance with Claim 1 or 8, characterized in that the material (03) is embodied with an even surface.

69. The optical system in accordance with Claim 1 or 8, characterized in that the material (03) is embodied as being flat.

70. The optical system in accordance with Claim 1 or 8, characterized in that the material (03) is embodied as a sheet (03).

71. The optical system in accordance with Claim 1 or 8, characterized in that the material (03) is embodied as a material web (03).

72. The optical system in accordance with Claim 1 or 8, characterized in that the material (03) is embodied as printed material (03).

73. The optical system in accordance with Claim 1 or 8, characterized in that the material (03) is composed of paper.

74. The optical system in accordance with Claim 1 or 8, characterized in that the material (03) is embodied as security paper (03) or as a bank note (03).

75. The optical system in accordance with Claim 1 or 8, characterized in that the surface (02) of the material (03) has a relief or some other structure that protrudes from the surface (02) or is pressed into the surface (02) as an indentation.

76. The optical system in accordance with Claim 1 or 8, characterized in that the width (B01) of the illuminated strip (01) is at least 3 mm.

77. The optical system in accordance with Claim 1 or 8, characterized in that the width (B01) of the illuminated strip (01) is at least 8 mm.

78. The optical system in accordance with Claim 1 or 8, characterized in that the distance (A07) from the surface (02) of the material (03) to each of the light sources (07) is between 30 mm and 200 mm.

79. The optical system in accordance with Claim 1 or 8, characterized in that the distance (A07) from the surface (02) of the material (03) to each of the light sources (07) is between 70 mm

and 140 mm.

80. The optical system in accordance with Claim 1 or 8, characterized in that the distance (A07) from the light sources (07) stands perpendicular to the surface (02) of the material (03).

81. The optical system in accordance with Claim 1 or 8, characterized in that a recording device (08) having at least one detector (09) located at a distance (A09) from the surface (02) of the material (03) captures light emitted by the light sources (07).

82. The optical system in accordance with Claim 1 or 8, characterized in that a recording device (08) having at least one detector (09) located at a distance (A09) from the surface (02) of the material (03) captures light reflected by the surface (02) of the material (03).

83. The optical system in accordance with Claim 81 or 82, characterized in that the recording device has several detectors (09) arranged one after the other in the direction of movement (04) of the material (03).

84. The optical system in accordance with Claim 81 or 82, characterized in that the recording device (08) has detectors (09) that are linearly arranged.

85. The optical system in accordance with Claim 83, characterized in that the linearly arranged detectors (09) of the recording device (08) are arranged parallel to the length (L01) of the illuminated strip (01).

86. The optical system in accordance with Claim 81 or 82, characterized in that the recording device (08) has a solid capture angle ($\alpha$), with the capture angle ($\alpha$) forming a cross-sectional area on the surface (02) of the material (03).

87. The optical system in accordance with Claim 86, characterized in that the recording device (08), with the cross-sectional area lying inside its capture angle ($\alpha$), captures at least part of the bundle of light beams emitted by the illumination device (06) across the width (B01) of the illuminated strip (01).

88. The optical system in accordance with Claim 81 or 82, characterized in that the recording

device (08) is embodied as a camera (08).

89. The optical system in accordance with Claim 81 or 82, characterized in that the recording device (08) is embodied as a line camera (08).

90. The optical system in accordance with Claim 81 or 82, characterized in that the detector (09) of the recording device (08) is embodied as a CCD array (09) or as a group of photo diodes (09).

91. The optical system in accordance with Claim 81 or 82, characterized in that the detector of the recording device (08) converts the captured reflected light into an electrical signal.

92. The optical system in accordance with Claim 91, characterized in that the detector (09) of the recording device (08) supplies the electrical signal to an image processing device (24).

93. The optical system in accordance with Claim 1 or 8, characterized in that it is arranged in a printing press.

94. The optical system in accordance with Claim 1 or 8, characterized in that it is arranged in a rotation printing press.

95. The optical system in accordance with Claim 1 or 8, characterized in that it is arranged in a printing press printing in an offset printing method or in a steel engraving method or in a serigraphy method or in a hot embossing method.

96. The optical system in accordance with Claim 1 or 8, characterized in that it is arranged in a machine that further processes a printed product.

97. The optical system in accordance with Claim 1 or 8, characterized in that it is embodied as an in-line inspection system.

98. An optical system for producing an illuminated strip (01) on a surface (02) of a material (03), with an illumination device (06) with its light sources (07) being arranged at a distance (A07) from the surface (02) of the material (03), with several light sources (07) of the illumination device

(06) being arranged in the longitudinal direction of this illumination device (06), with the illumination device (06) with its light-emitting light sources (07) producing an illuminated strip (01) on the surface (02) of the material (03), which is moving relative to the illumination device (06), characterized in that a control device (23) connected to the illumination device (06) controls at least one of the light sources (07) arranged in the longitudinal direction of the illumination device (06) individually and independently of at least one other light source (07) arranged in the longitudinal direction of the illumination device (06).

99. The optical system in accordance with Claim 98, characterized in that the control device (23) connected to the illumination device (06) selectively activates the light sources (07) arranged in the longitudinal direction of the illumination device (06).

100. The optical system in accordance with Claim 98, characterized in that the control device (23) connected to the illumination device (06), using the light sources (07) arranged in the longitudinal direction of the illumination device (06), adapts the length (L01) of the illuminated strip (01) to the width (B03) of the material (03) to be illuminated.

101. The optical system in accordance with Claim 98, characterized in that the control device (23) connected to the illumination device (06), using the light sources (07) arranged in the longitudinal direction of the illumination device (06), illuminates selected areas on the surface (02) of the material (03) in the longitudinal direction of the illumination device (06).

102. The optical system in accordance with Claim 101, characterized in that the illuminated areas on the surface (02) of the material (03) in the longitudinal direction of the illumination device (06) are interrupted by areas that are not illuminated or are illuminated in a different color.

103. The optical system in accordance with Claim 98, characterized in that the light sources (07) arranged in the longitudinal direction of the illumination device (06) are divided into groups.

104. The optical system in accordance with Claim 98, characterized in that the illumination device (06) has several modules (M61 to M65) arranged in a row next to one another.

105. The optical system in accordance with Claim 98, characterized in that the light sources (07) each feed their light into a reflector module (39), with the reflector module (39) forming one single

component with the diffuser (38) and the mirrors (11; 16).

106. The optical system in accordance with Claim 104, characterized in that each module (M61 to M65) has at least one light source (07) or at least one group of light sources (07).

107. The optical system in accordance with Claim 105, characterized in that at least one module (M61 to M65) has at least one reflector module (39).